

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

1
Ag84F
Reserve

FLEAS *and Their Control*

F. C. BISHOPP

ENTOMOLOGIST, INSECTS AFFECTING THE HEALTH OF ANIMALS



Adult Female of the Human Flea, Greatly Enlarged

FARMERS' BULLETIN 897
UNITED STATES DEPARTMENT OF AGRICULTURE

rev. Mar. 1926

OF THE APPROXIMATELY 500 species of fleas known to exist, less than one dozen are of special interest as pests to man and domestic animals, but any individual of one of these few species, when bent upon satisfying its appetite, fully occupies the attention of its chosen host.

The human flea, dog flea, cat flea, sticktight flea or chicken flea, and the rat fleas (which carry the bubonic plague), are the principal species that annoy man and domestic animals in the United States.

The main steps in control, as described in this bulletin, are the elimination of breeding places and the destruction of fleas on the infested animals. If breeding places receive proper attention the premises often will be cleared of fleas, even though little or no attention is given to the animals themselves.

Fleas breed in greatest numbers in accumulations of vegetable and animal matter protected from wind and rain, but at the same time furnished with shade and a certain amount of moisture. All live stock should be prevented from going beneath buildings, the vegetable and animal matter carefully cleaned up, and the ground where the immature fleas are developing covered with salt and thoroughly wet down. House infestations may be prevented by eliminating pet animals and applying gasoline to the floors after all rugs have been removed and the floors thoroughly scrubbed with soap and water. Washing pet animals in a comparatively weak solution of saponified creosote or kerosene emulsion will destroy the fleas upon them.

FLEAS AND THEIR CONTROL.

CONTENTS.

	Page.		Page.
Life history and habits.....	3	Means of repression.....	10
Length of life of the adult.....	5	Remedies for household infestations.....	10
Abundance of fleas, with relation to season, climate, and other conditions.....	5	How to kill fleas on cats, dogs, and hogs..	10
Fleas as pests in the household.....	6	Control of hosts.....	11
Fleas injurious to poultry and domestic ani- mals.....	7	How to destroy fleas in immature stages.	11
The sticktight flea.....	7	Trapping fleas.....	13
Dog and cat fleas.....	8	Isolating and repelling.....	14
The relation of fleas to bubonic plague.....	9	Methods of controlling the sticktight or chicken flea.....	14
		Treatment of flea bites.....	15

FLEAS AFFECT US IN TWO WAYS: First, as disease carriers, and, second, as parasites or annoyers of man and animals. The dread bubonic plague has been found to be transmitted largely, if not entirely, through the agency of these insects. A disease known as infantile kala azar, occurring in the countries bordering the Mediterranean Sea, is probably also transmitted by them, and a species of tapeworm which infests dogs and occasionally people has been found to pass at least one stage in the dog flea and then to gain entrance to a new host by the swallowing of crushed or living fleas. The recent war, with its movement of vast bodies of troops between various parts of the world, had its attendant danger of spreading disease, and it is probable that the dangers along this line are just as acute now, owing to the unsettled conditions that prevail in various countries.

Aside from the transmission of diseases fleas are of considerable importance as parasites of man and animals. In many instances they have been known to render houses uninhabitable for a time, and certain species cause considerable loss among poultry as well as annoyance to other animals.

LIFE HISTORY AND HABITS.

Fleas are of many kinds. Most of them, however, are of no importance to man, as they feed on various wild birds and mammals. Nearly all species have some one host upon which they prefer to live, but they may feed upon other animals and often thrive upon them. For example, the dog flea (fig. 1)¹ normally feeds on dogs and cats,

¹ The fleas mentioned in this bulletin are known scientifically as follows: Dog flea, *Otenocephalus canis* Curtis; cat flea, *Otenocephalus felis* Bouché; human flea, *Pulex irritans* L.; rat fleas, *Xenopsylla cheopis* Roth. (the Indian rat flea), *Ceratophilus fasciatus* Bosc. (the European rat flea), and others; chigoe, *Dermatophilus penetrans* L.; sticktight or chicken flea, *Echidnophaga gallinaceus* Westw.

but when excessively numerous may prove a troublesome pest to man; the human flea normally attacks man, but may be found on a number of other animals; rat fleas, in the absence of their usual hosts, will bite man, and these fleas are the ones ordinarily responsible for the inoculation of man with bubonic plague.

Fleas of different species vary markedly in the intimacy with which they are associated with their hosts. Some kinds remain upon host animals practically all the time. In fact, the chigoe flea normally buries itself in the skin of the host and there develops its eggs and dies. The sticktight flea, or chicken flea, has the habit of intimate association with the host, but does not bury itself in the flesh of the animal. Dog fleas ordinarily remain upon the

domestic animals almost continuously throughout their existence, but are not attached and feed only at intervals. The human flea remains upon man but little, being elsewhere the greater portion of the time.

The life of the flea has four distinct stages, as is the case with many other insects; these stages are the egg, larva, pupa, and adult.

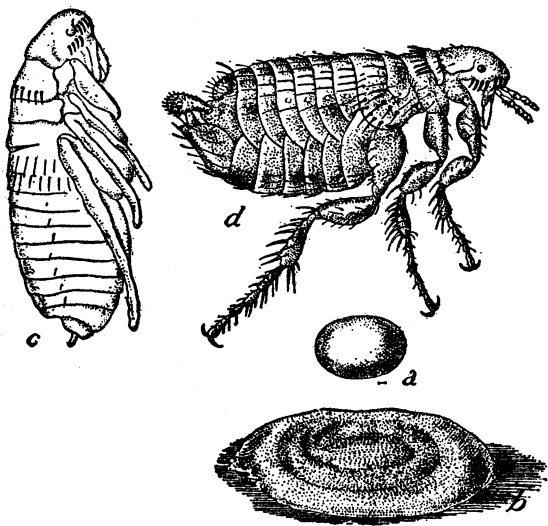


FIG. 1.—The dog flea: *a*, Egg; *b*, larva in cocoon; *c*, pupa; *d*, adult. *b*, *c*, *d*, Much enlarged; *a*, more enlarged. (Howard.)

A number of eggs are deposited by each adult female flea. The egg laying, alternated with feeding, extends over a considerable time. In most cases the eggs are deposited by the fleas while the latter are on the animal host, but as they usually are not cemented to the hair or feathers they fall out in the nest or resting place of the animal. The eggs are cream-colored or white and ovoid. Large numbers of them often may be seen on mats or cushions upon which infested dogs or cats sleep. Especially are they easily observed when on dark-colored cloths. Hatching usually takes place from 2 to 12 days after deposition.

The larva when first hatched is whitish, very minute, and quite active. (See fig. 2, larva of European rat flea.) In this stage fleas are not parasitic. They depend upon various animal and vegetable débris, including the excrement of the adult fleas, for food. During

their growth the skin is shed twice, and between four days and several months after hatching a silken cocoon is spun, and in this the larva transforms to the pupa or resting stage.

The insect remains within the cocoon for a period which may range from three days to more than a year.

The complete life cycle of members of this group of insects may be passed in as short a period as 17 days, but during cool weather or under adverse conditions the total period from egg to adult may extend considerably over a year.

LENGTH OF LIFE OF THE ADULT.

The length of life of the mature flea varies much as between different species and under different atmospheric conditions. During hot, dry weather, and when no animals upon which to feed are present, the duration of life may be extremely short—from two to five days. When allowed to feed on blood, which is the only food taken by the adults, they may live from a month to almost a year.

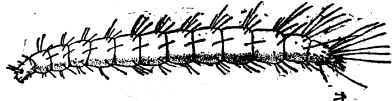


FIG. 2.—The European rat flea: Larva. Greatly enlarged.

During summer probably the average longevity of the human flea without food is about two months, of the dog flea somewhat less, and of the sticktight flea still less.

ABUNDANCE OF FLEAS, WITH RELATION TO SEASON, CLIMATE, AND OTHER CONDITIONS.

In the northern part of the United States nearly all fleas pass the winter in the immature stages, while in the more southern latitudes some of them are present on hosts throughout the winter months. In general, however, these insects are never as abundant during winter and spring as they are in summer and fall. In the extreme Southern States this is not always true, as much trouble from the human, dog, and sticktight fleas has been observed to occur in late spring or early summer when rains were frequent and the humidity high.

Rainfall and the amount of moisture in the atmosphere have much to do with flea breeding. As a rule rainy summers are productive of outbreaks of fleas, and extremely hot, dry weather tends to check their breeding. The larva and pupa require a certain amount of moisture for successful development, and the adults live longer when a proper degree of moisture is present. It would be erroneous, however, to infer from this that fleas require very moist places in which to breed; in fact excessive moisture in the breeding places is as detrimental as is excessive dryness. This sensitiveness to excessive moisture can be utilized in remedial work, as will be pointed out later.

It is common knowledge that fleas occur in greatest abundance in sandy regions. This is explained by the fact that sand maintains moisture more uniformly, and thus permits the immature stages of the flea to develop with greater success. The sand also offers some protection to the adults and renders heavy rains less destructive to all stages of the flea present on the soil.

FLEAS AS PESTS IN THE HOUSEHOLD.

As has been pointed out,¹ in the eastern part of the United States the dog flea is the species of greatest importance as a household pest. Many instances have been brought to the attention of the Bureau of



FIG. 3.—The human flea: Adult male. Greatly enlarged. Note the difference in the shape of the abdomen of the male as compared with that of the female (title-page).

Entomology in which houses, particularly those vacated for some time during the summer months, have been found to be literally overrun by the pests.

In portions of the South and West the human flea (title-page illustration and fig. 3) is the one primarily responsible for house infestations. Although the host relationship of these two species is somewhat different, the same methods of control are applicable, for the most part, to both. When comparatively small numbers of fleas are found on people in houses, breeding places should be

sought out of doors in sheds or barns frequented by dogs and cats, especially if the house is kept clean and animals do not frequent it.

The conditions which give rise to severe outbreaks in houses, particularly in the case of the dog or cat fleas, are usually these: Pet dogs or cats are kept about the household during the spring and early summer, and great numbers of eggs are deposited upon them by the fleas. These eggs are scattered about the floors and soon hatch into minute maggots which feed upon the vegetable and animal matter under carpets and mattings and in cracks. During this time the house may have been closed up during a vacation period and the breeding allowed to proceed unchecked, so that at about the time the occupants return the fleas have reached the adult stage. In the absence of other hosts they are exceedingly hungry and ready to attack man or any animals which are accessible.

¹ Howard, L. O. House Fleas. U. S. Dept. Agr. Bur. Ent. Cir. 108, 4 p., 2 figs., Feb. 11, 1909.

Some infestations of residences come from breeding places beneath the houses. The fleas in these cases usually are furnished by stray animals which sleep under the buildings. The immature stages develop in the accumulation of dust and vegetable matter in the beds of these animals. Instances are not uncommon in which such infestations have extended to lawns, barnyards, and, in fact, all over the premises, although as a rule the center of infestation is in some one definite place frequented by animals.

The infestations of the human flea are usually less severe than in the extreme cases above mentioned, and the breeding places often are more widely extended.

A number of instances in the Southern and Central Western States have come to notice in which hogs appear to have been the source of gross infestations by the human flea. The adult fleas feed on the hogs and breeding takes place in the beds of these animals. In some instances the source of infestation is in the hog runs, but more usually it is derived from hogs sleeping under houses or in barns.

FLEAS INJURIOUS TO POULTRY AND DOMESTIC ANIMALS.

Fortunately the higher domestic animals are comparatively free from flea attacks. Horses, cattle, sheep, and goats are seldom seriously annoyed, although a few instances have been noted in which the sticktight flea infested horses, and mules and horses are sometimes worried considerably by the human flea and may refuse to stay in infested barns even long enough to eat. Hogs are infested to some extent, but seldom heavily enough to do any great damage.

THE STICKTIGHT FLEA.

The sticktight flea, or southern chicken flea (figs. 4, 5), probably is the most important of our live-stock infesting species. This form attacks a number of different hosts, including poultry, dogs, cats, and some wild animals. As has been stated, the adult fleas remain during the greater part of their lives attached to the host animal. On dogs and cats they are largely found on the ears, particularly along the edges. In the case of poultry infestations fleas are most common on the heads of the hosts, where they are to be seen in groups or patches. This habit of attaching in clusters seems to be well marked, and an infested fowl often may be recognized at a considerable distance by the dark flea-covered areas about the eyes, comb, and wattles. Figure 4 illustrates the usual mode of infestation on a chicken's head, and figure 5 shows one of the fleas much enlarged. When the fleas are excessively abundant they may be found in similar patches on the neck and various parts of the body.

This flea is most common and is of greatest importance in the Southern and Southwestern States. It has been reported as injurious to poultry as far north as Kansas. The injury is most marked in young chickens, which when fairly heavily infested often die quickly.

Older fowls are more resistant, but have been known to succumb to very heavy infestations; and certainly the fleas materially reduce the egg production, retard the growth of fowls, and diminish their size.

The eggs are deposited by the adult flea while it is attached to the host. They fall to the ground under the roost in chicken houses or under sheds frequented by the poultry and there continue to develop. When dogs and cats are infested, the immature stages develop largely in the material used by them for beds. They require comparatively dry material in which to breed, but a large amount of air moisture is favorable to them. Adults of this species continue to emerge from infested trash for four or five months after all hosts have been removed; hence it is easy to understand why chicken



FIG. 4.—Head of rooster infested with the sticktight flea. Reduced.

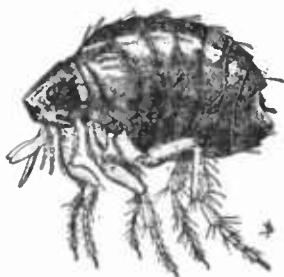


FIG. 5.—The sticktight flea: Adult female. Much enlarged.

houses may still have many fleas in them after being unused for considerable periods.

A few other species of fleas are occasionally found in poultry houses. Some of these may be normally bird-infesting species, while others are at home in the houses of domestic poultry. Infestations by these fleas have been reported from several places in the Northern States, particularly in the Northwest¹ and in the New England States.² The presence of the fleas is usually first detected by persons entering chicken houses and being attacked by them. These fleas do not remain attached to the host continuously as does the sticktight flea. They are seldom of great importance and may be controlled by the methods outlined on pages 10-14.

DOG AND CAT FLEAS.

Dogs and cats are infested by two very closely related species of fleas,³ and these appear to feed more or less interchangeably on the

¹ Known scientifically as *Ceratophitus niger* Fox.

² *Ceratophitus gallinae* Schrank and *C. gibsoni* Fox.

³ The cat flea is known scientifically as *Ctenocephalus felis* Bouché and the dog flea as *Ctenocephalus canis* Curtis. The human flea also is not uncommonly found on dogs and cats.

two hosts, as well as occasionally on man and other animals. While they cause these hosts much annoyance and, as has been pointed out, are also responsible for the infestation of dogs by tapeworms, serious injury seems to be unusual. The annoyance often makes the hosts irritable and cross, which is especially objectionable in the case of pets. In the case of valuable dogs and cats it is desirable to rid them of fleas, and in all cases where these animals are closely associated with man the control of the fleas upon them is of importance. As will be seen by comparing figure 1 with figure 5 the dog flea is quite different from the sticktight flea in structure as well as in size. The adults do not remain attached to the host in one place, but the life history is not vastly different from that of the sticktight flea. Breeding takes place in similar materials in situations occupied by the host animals. Mr. Theodore Pergande, working with the dog flea at Washington, D. C., found the life cycle from egg to adult to be completed within 17 to 37 days. It is thus seen that a great number of fleas might be produced in and beneath an unoccupied house in a comparatively short period.

Both of these species have a very wide distribution, being found in practically all parts of the world where dogs and cats are found.

THE RELATION OF FLEAS TO BUBONIC PLAGUE.

During recent years bubonic plague has been introduced into the United States on both the Pacific and Gulf Coasts. The infestation in California has persisted for a number of years, although closely held in check through the efforts of the Public Health Service and the State board of health. The disease around San Francisco not only persisted among the rats, but gained a foothold among ground squirrels in the counties adjacent to San Francisco Bay.

During the year 1914 the disease broke out in New Orleans, but strict quarantine measures and an energetic campaign against the rats¹ kept the malady from spreading and limited the number of human cases.

With the reduction in numbers of rats and mice there is a correspondingly great decrease in the numbers of the species of fleas which infest them and which may play a part in carrying bubonic plague. The cleaning up of the breeding places of rats and the destruction of their nests will accomplish the extermination of a large number of fleas in the immature stages.

Persons resident in districts where plague occurs among the ground squirrels should remember that there is danger of infection from the bites of fleas which infest these animals.

¹ The methods of rat control are discussed in Farmers' Bulletin 896, U. S. Department of Agriculture, by Mr. D. E. Lantz, of the Bureau of Biological Survey.

MEANS OF REPRESSION.

Certain general principles regarding the control of fleas are applicable to nearly all species, but some modifications of the methods employed are necessary for different species, and under the different conditions in which they exist.

REMEDIES FOR HOUSEHOLD INFESTATIONS.

As has been pointed out, the dog flea and the human flea are the two most important species invading the habitations of man. It has also been suggested that the adult fleas feed more or less on cats and dogs and that the immature stages develop in the cracks of floors and beneath houses. It therefore is apparent at once that two steps are necessary to cope with the pest: (1) The destruction on the host of the adults which are producing the eggs, and (2) the clearing out of the immature stages which are breeding in or under the house.

HOW TO KILL FLEAS ON CATS, DOGS, AND HOGS.

One of the most successful methods of killing fleas on cats and dogs is to wash the animals thoroughly in a tub containing the proper proportion of a saponified coal-tar creosote preparation, of which there are a number on the market, known as "stock dips," etc. The animal should be scrubbed thoroughly, special precaution being taken that the fleas on the head are well soaked, as many rush there to get away from the parts that are covered with the solution. After the animal has been in the bath for about 5 or 10 minutes it may be removed and allowed to dry. In the case of cats the preparation should be washed out of the fur with soap and warm water soon after the animal is taken out of the solution. Since some cats are sensitive to dips containing phenol, it is safer to use pyrethrum powder on valuable animals rather than the creosote dips.

In addition to the destruction of all fleas present, this washing cleanses and deodorizes the fur and also aids in the healing of any wounds which are present.

The thorough washing of infested animals in kerosene emulsion is a cheap and satisfactory method of destroying fleas. Five gallons of this emulsion may be made by dissolving 2 ounces of washing soap in 1 quart of hot water and when brought to a boil removing it from the fire and adding $2\frac{1}{2}$ pints of kerosene. The mixture should be agitated violently with an egg-beater or something of the sort. This should result in a milky mass from which the oil does not separate. Water is then added to make 5 gallons. Free kerosene will burn animals, and if any separates out the mixture should be reheated, care being taken to avoid spilling it on the fire or boiling it over, and then it should be beaten again.

Other methods of destroying fleas on cats and dogs have been recommended. Among these the careful rubbing into the hair of powdered naphthalene or moth balls has been found effective. Pyrethrum or Persian insect powder is used in the same way. Both of these materials stupefy the insects and cause them to come to the surface of the hair or actually drop out. The animals should be treated on papers spread on the floor and the insects burned after the dusting is completed. The pyrethrum powder must be fresh.

Recent experiments with the use of the powdered roots of certain tropical plants known as derris indicate that this drug when fresh is exceedingly effective in destroying fleas on animals. All fleas on a dog will be destroyed by one application of 1 gram or about three-fourths of a level teaspoonful of the powder. It is suggested that the material be mixed at the time it is used with two parts of flour or cornstarch and dusted into the hair of the animal, especially along the back and neck, with a shaker.

The skin of cats is much more easily injured with chemicals than that of dogs; hence, any preparation used should be weaker when used on cats than on dogs.

Fleas on hogs may be destroyed by dipping the animals in a vat containing one of the creosote dips used for the hog louse or by sprinkling crude petroleum on them when they are crowded into a corner.

CONTROL OF HOSTS.

In order to avoid the infestation of houses, it is important that all animals be kept from beneath dwellings. In such situations breeding may progress rapidly, and it is very difficult to treat the breeding places. If fleas are continuously annoying about the household, it is often desirable not to admit cats and dogs at all, but to provide regular sleeping quarters for these animals out of doors and prevent flea breeding by methods suggested in the following paragraph. Stray cats and dogs should not be encouraged about the premises. In towns and cities the enforcement of the dog-tax law and the destruction of all untagged animals will tend greatly to reduce house infestations. It is also desirable to keep different kinds of animals which are subject to flea infestation separated, and care should be exercised that infested animals are not brought to clean premises and that infested poultry are not placed with a clean flock.

HOW TO DESTROY FLEAS IN IMMATURE STAGES.

Following the ridding of infested animals of adult fleas, it is important to destroy the immature fleas, which are constantly becoming full grown and reinfesting animals and annoying man.

When adult fleas are very numerous it is advisable to kill them before proceeding to destroy the young. Experiments of a practical nature prove that very striking results may be accomplished by the spraying of an infested area, whether in a basement, chicken house, barn, or feed lot, with creosote oil. A light spraying kills the adult fleas almost instantly and apparently has some destructive effect on the immature stages.

Creosote oil is derived from coal tar and is used as a wood preservative. It is comparatively cheap, retailing at about 50 cents per gallon. Unfortunately it is not generally available at present and it is somewhat variable in composition, especially in regard to the amount of tar acids present. The best results are secured with a product containing from 12 to 20 per cent tar acids. Where there is grass or shrubbery to be considered, kerosene emulsion should be substituted for the creosote oil, which will kill vegetation. Care should also be taken not to strike animals directly with the material, as it is rather caustic. In houses the use of flaked naphthalene as described in a later paragraph will permit the work of cleaning to proceed without annoyance from adult fleas.

In household infestations usually it is found that the breeding takes place in the cracks of floors or beneath carpets or in rooms which are not frequently swept, but which may be visited by pet dogs and cats. The carpets and rugs should be removed, the floors thoroughly swept, and all of the dust thus obtained burned, as it contains many of the eggs and maggots of the fleas. Then the floor should be scrubbed with strong soapsuds or sprinkled with gasoline, care being taken to avoid having fires about during the procedure. After the floor coverings are thoroughly aired and beaten they may be returned, but it is desirable before putting them down to sprinkle the floor with naphthalene crystals or pyrethrum powder.

In flea-infested regions it is advisable to avoid the use of matings and carpets. These may be supplanted by rugs or oiled floors, which facilitate frequent sweeping and make the destruction of the immature stages easier if an infestation becomes established.

Among other methods for destroying the fleas in houses the following have been tried and recommended: Scatter 5 pounds of flake naphthalene over the floor of an infested room and close the doors and windows tightly for 24 hours. After this period the naphthalene may be swept into another room, and so on, thus making the treatment inexpensive. The free use of alum, both in the powdered form sprinkled over carpets and rugs and by dipping papers in an alum solution and placing them under the rugs, is said to give satisfactory results. The fumigation of houses with sulphur fumes or hydrocyanic-acid gas kills all fleas present and in addition destroys the rats

and mice. When sulphur is to be employed the infested building should be closed up tightly and the material used at the rate of 4 pounds to each 1,000 cubic feet of space. If the immature stages have been destroyed by the methods mentioned, 2 to 3 pounds of sulphur per 1,000 cubic feet of space will be sufficient to destroy the adults. The sulphur is made into a cone-shaped mass in a good-sized pan or kettle and placed in a larger pan containing water to avoid danger of fire from the heat generated. As sulphur will not burn readily at first a little alcohol is poured into a depression made in the top of the cone, and a match applied. Each room should have a pan of sulphur, and the rooms should be kept closed about 12 hours. As the gas generated from burning sulphur corrodes metals and injures plants, it is necessary to remove metal objects and potted plants before fumigation. It is not advisable for anyone to undertake the use of hydrocyanic-acid gas without obtaining the complete directions for its employment contained in Farmers' Bulletin 699, entitled "Hydrocyanic-Acid Gas Against Household Insects." This gas is very poisonous, but it is one of the most satisfactory for destroying all sorts of vermin in buildings.

When house infestations are derived from fleas which breed beneath or around houses, the first step is to clean out all the loose material in which fleas may be breeding and burn it. Then common salt should be scattered about and thoroughly wet down. A second wetting two or three days later usually will accomplish complete destruction, but if this is not found sufficient, one or two additional wettings may be given. Where crude petroleum is cheap and especially where water can not be applied easily, sprinkling the ground with a liberal amount of this oil will give good results. The free use of lime on the cleaned areas also apparently destroys many immature fleas. In exceptional cases lawns become infested, and fleas breed out around the roots of the grass. It is impracticable to apply chemicals in such situations, but much may be done to check the breeding by cutting the grass exceedingly short and thus exposing the young fleas to the heat of the sun, which will usually accomplish their destruction. In certain sections it has been found feasible to destroy flea infestations in barns and hog runs by diking the infested areas and pumping water in so as to flood them entirely.

TRAPPING FLEAS.

Following the treatment of host animals and the thorough cleaning up of the premises, as has been outlined, many of the remaining adult fleas may be caught by the use of traps.

There seems to be some virtue in the use of lights at night for attracting the adult fleas. A small lamp set in a pan of water covered with a film of kerosene may be used for this purpose.

It has been found that a considerable number of fleas may be collected about a room or cellar by allowing an animal such as a guinea pig or cat to be free in the room. The fleas thus concentrated on the animal may be destroyed by the methods mentioned under the heading, "How to kill fleas on cats, dogs, and hogs" (p. 10). In districts where the plague is known to exist and it is desirable to catch the few fleas about the premises, this method is of some value.

ISOLATING AND REPELLING.

It has been determined that the greatest horizontal distance fleas can jump is about 13 inches, and they can not jump more than one-half of this distance vertically. It is possible, therefore, to prevent them from gaining access to a bed by placing sticky fly paper about 13 inches wide on the floor around the bed, provided fleas are not breeding out under it. It is also possible to keep fleas out by placing the legs of the bed in pans of water covered with a film of kerosene, if the bedding is prevented from reaching near the floor.

Many different substances have been advocated as repellents for fleas. Among these may be mentioned such plants as pennyroyal and boughs and chips of pine. Naphthalene crystals and pyrethrum have also been employed for dusting between the sheets in order to repel the fleas from bedding, and these substances, as well as oil of pennyroyal and oil of tar, may be used about the household to drive out the fleas.

It should be borne in mind that the methods of trapping and repelling just discussed are secondary to the more important measures of destroying the breeding places and freeing hosts from fleas.

METHODS OF CONTROLLING THE STICKTIGHT OR CHICKEN FLEA.

Many of the suggestions for controlling fleas in the household are applicable to the sticktight flea. As has been pointed out, this species breeds largely in chicken houses and adjacent buildings frequented by the fowls, although dogs and cats may be important sources of infestation.

As a preliminary step it is well to see that the poultry are kept away from other animals as far as possible. Especial care should be exercised to keep dogs and cats from lying about the chicken yards or places frequented by the poultry. All animals, and the poultry as well, should be excluded from beneath houses and barns, as such places are favorable for flea development and difficult to treat if they become infested. These precautions should be followed by a thorough cleaning out of the chicken house and outbuildings frequented by the poultry. All of the material should be hauled a good distance from the buildings and scattered. The places where

the fleas are thought to be breeding should then be sprayed with creosote oil. This species can not thrive in damp places, and if the breeding areas are well soaked with a hose or by flooding two or three times at weekly intervals no further breeding will take place. One of the most satisfactory methods of preventing breeding is to scatter salt freely about the chicken house and then wet the soil down thoroughly. *Fowls should not be permitted to eat the salt, as it is poisonous to them.*

It is rather difficult to destroy the sticktight flea on fowls without injuring the host. It is desirable, however, in the case of heavy infestations to destroy as many of the fleas as possible. This may be accomplished by carefully applying carbolated vaseline to the clusters of fleas on the fowls, or greasing them with kerosene and lard—1 part kerosene to 2 parts lard. In all cases care should be taken that the applications of grease are confined to the seat of infestation. It is important that dogs and cats be freed from sticktight fleas. This may be accomplished by washing them in a saponified coal-tar creosote preparation, as has been described, or by greasing the most heavily infested parts with kerosene and lard. Rats sometimes harbor these fleas in considerable numbers, therefore their destruction will aid in the control work as well as doing away with another troublesome chicken pest.

The thorough cleansing of poultry houses and runs and the application of crude petroleum or carbolineum will be found to aid in the control of other important enemies of fowls, such as mites and chicken ticks or "blue bugs."

TREATMENT OF FLEA BITES.

In regions in the United States where the plague is not known to occur no special concern need be felt regarding flea bites. When feeding, the fleas inject a salivary secretion which tends to produce inflammation at the site of the puncture. Usually the bites result in small inflamed spots, but occasionally, where the pests are very numerous and in the case of susceptible individuals, more general inflammation may occur, sometimes followed by swelling and, occasionally, especially after scratching, by ulceration.

Those who are especially annoyed by the bites will find that various cooling applications will give relief. A 3 per cent solution of carbolic acid in water applied to the bites will be beneficial, and such substances as menthol, camphor, and carbolated vaseline will be found to allay the irritation. Iodine in the form of a tincture, if applied to the bites, will alleviate the irritation, but should not be used by persons afflicted with any form of eczema, or applied to the tender skin of young children, as it may stimulate the eczemic eruptions or blister the skin, causing undue annoyance.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

March 26, 1926

<i>Secretary of Agriculture</i> -----	W. M. JARDINE.
<i>Assistant Secretary</i> -----	R. W. DUNLAP.
<i>Director of Scientific Work</i> -----	
<i>Director of Regulatory Work</i> -----	WALTER G. CAMPBELL.
<i>Director of Extension Work</i> -----	C. W. WARBURTON.
<i>Director of Information</i> -----	NELSON ANTRIM CRAWFORD.
<i>Director of Personnel and Business Adminis-</i> <i>tration</i> -----	W. W. STOCKBERGER.
<i>Solicitor</i> -----	R. W. WILLIAMS.
<i>Weather Bureau</i> -----	CHARLES F. MARVIN, <i>Chief</i> .
<i>Bureau of Agricultural Economics</i> -----	THOMAS P. COOPER, <i>Chief</i> .
<i>Bureau of Animal Industry</i> -----	JOHN R. MOHLER, <i>Chief</i> .
<i>Bureau of Plant Industry</i> -----	WILLIAM A. TAYLOR, <i>Chief</i> .
<i>Forest Service</i> -----	W. B. GREELEY, <i>Chief</i> .
<i>Bureau of Chemistry</i> -----	C. A. BROWNE, <i>Chief</i> .
<i>Bureau of Soils</i> -----	MILTON WHITNEY, <i>Chief</i> .
<i>Bureau of Entomology</i> -----	L. O. HOWARD, <i>Chief</i> .
<i>Bureau of Biological Survey</i> -----	E. W. NELSON, <i>Chief</i> .
<i>Bureau of Public Roads</i> -----	THOMAS H. MACDONALD, <i>Chief</i> .
<i>Bureau of Home Economics</i> -----	LOUISE STANLEY, <i>Chief</i> .
<i>Bureau of Dairying</i> -----	C. W. LARSON, <i>Chief</i> .
<i>Fixed Nitrogen Research Laboratory</i> -----	F. G. COTTRELL, <i>Director</i> .
<i>Office of Experiment Stations</i> -----	E. W. ALLEN, <i>Chief</i> .
<i>Office of Cooperative Extension Work</i> -----	C. B. SMITH, <i>Chief</i> .
<i>Library</i> -----	CLARIBEL R. BARNETT, <i>Librarian</i> .
<i>Federal Horticultural Board</i> -----	C. L. MARLATT, <i>Chairman</i> .
<i>Insecticide and Fungicide Board</i> -----	J. K. HAYWOOD, <i>Chairman</i> .
<i>Packers and Stockyards Administration</i> -----	JOHN T. CAINE III, <i>in Charge</i> .
<i>Grain Futures Administration</i> -----	J. W. T. DUVEL, <i>in Charge</i> .

This bulletin is a contribution from

Bureau of Entomology----- L. O. HOWARD, *Chief*.

